PIER DEMAND RESPONSE RESEARCH CENTER

Research Opportunity Notice DRRC RON – 01

Establish the Value of Demand Response
Develop an Integrated Efficiency / Demand Response Framework

Final – July 21, 2005

Research Goal

The purpose of this Research Opportunity Notice (RON) is to solicit proposals for research that will develop two key products:

(1) A more comprehensive understanding of the scope and value of demand response (DR) in California and
(2) A method or methodologies that can combine the metrics of DR valuation in a decision-oriented actionable value for California.

Background

The value of DR in California has been determined by a Standard Practice Methodology (SPM)[1] developed in the late 1970's and early 1980's. The SPM was originally designed to establish generation equivalence for DR, not to evaluate DR in its entirety. Then and now, DR value is evaluated using a present value analysis that considers the unit cost of a gas-fired peaking plant to assign value to the expected kilowatt (kW) load impacts, regardless of the supply needs of the particular utility service area.

There is a general consensus that the current evaluation framework, the present value analysis methodology and the peaking unit proxy valuation improperly capture and reflect the appropriate DR value.[2] The SPM falls short on both the benchmarks and the methodology used to value DR. The SPM only addresses static, readily quantifiable energy costs and benefits. Customer, environmental, societal, risk, information, opportunity and other difficult to quantify costs and benefits are excluded entirely.

There is a need to establish a new, more comprehensive evaluation framework to describe what should and should not be included to evaluate DR. There is also a need to identify a more inclusive and more robust DR valuation methodology. Specifically, research projects under this Research Opportunity Notice must examine the following fundamental issues.

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[1] California Public Utilities Commission, Energy Efficiency Policy Manual, Version 2, August 2003, http://www.cpuc.ca.gov/static/Industry/electric/energy+efficiency/rulemaking/resource4.pdf#search='Energy%20Efficiency%20Policy%20Manual'. Recent work by Energy and Environmental Economics, Inc for the California Public Utilities Commission updated the long term avoided costs for evaluating energy efficiency programs, see http://www.ethree.com/cpuc_avoidedcosts.html, October 2004.

[2] California Energy Commission, Briefing Paper: Problems with the Standard Practice Methodology, Levy Associates, August 2003.

- Customer Service Standard Assumptions: Instead of starting with a preferred or ideal service standard, the SPM implicitly assumes that 'current service' is the benchmark against which all other options should be measured. This assumption ignores customer needs and handicaps demand-side options that have the potential to deliver improved billing options, power quality, reliability, and information services. Furthermore, the SPM emphasizes a limited set of traditional demand-side options, those with restricted participation requirements, fixed incentives and utility controlled load impacts. Pricing and other more complex options with market-based incentives that can induce a variety of load and usage impacts cannot easily be addressed.
- Scope of Analysis: The SPM excludes qualitative and other difficult to quantify components of customer energy service. This practice is particularly biased against new technology initiatives that have major impacts on both the quality and reliability of customer service as well as complimentary environmental and other potentially beneficial regulatory or societal impacts.

  For example, the SPM has an inherent bias against any hardware or technology oriented demand-side option like on-site backup or distributed generation that requires an investment and results in either an increase in usage or net increase in the customer costs, regardless of the value received by the customer. Other examples include: shifting load from peak to off-peak time periods, energy information services, synchronized billing, any other value-added customer services and advanced metering that might allow more timely regulatory rate and incentive options in response to market perturbations.
- Valuation of Impacts: The SPM uses utility resource costs to value changes in customer usage. This approach fundamentally reverses basic principles of welfare economics and resource planning. Electric system resources, like other customer services, should be designed based on customer needs and requirements or a measure like customer willingness to pay, which is determined by the value customers derive from its use, not the utility's cost for not providing the next unit of service.

Demand response is also undergoing a number of fundamental changes that need to be recognized in this research. Historically, demand response is characterized as a utility program employing a single technology targeted at a customer group to curtail load during peak periods.

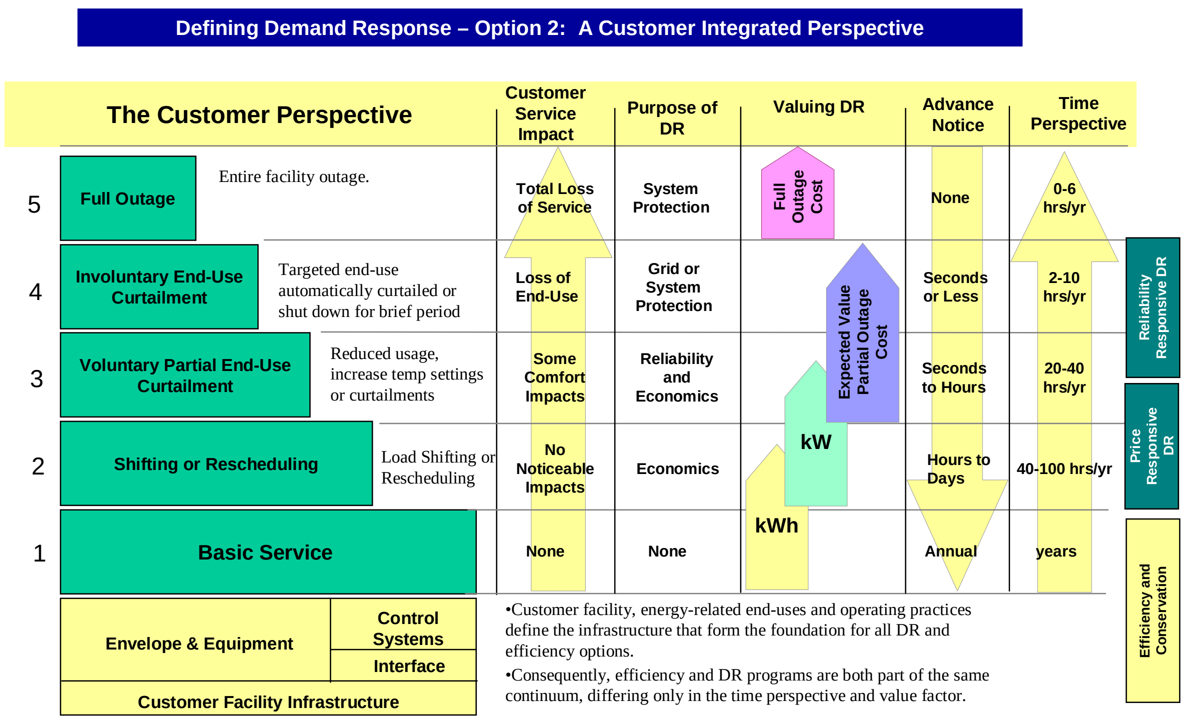
Conceptually, there is recognition that DR can represent a much broader range of actions that increase customer responsiveness (magnitude of change in usage pattern, curtailment or sacrifice of service) with real or perceived increases in expected price or loss of service. For example, customers may respond to TOU pricing by permanently reducing lighting levels or replacing an older water heater or HVAC system with a more efficient system. The California Statewide Pricing Pilot (SPP)[3] demonstrated that customers respond to Critical Peak Pricing (CPP) with additional reductions in peak load by either deferring certain services or by temporarily reducing comfort settings. Evaluations of customer response to energy shortages in 2000-2001 showed that customer make even deeper temporary reductions in peak load to prevent rotating outages. Figure

[3] Impact Evaluation of the California Statewide Pricing Pilot, Final Report, March 16, 2005, Charles River Associates.

1 depicts this conceptual range of customer response as five distinct sets of actions or impacts from a customer perspective.

The column titled "Valuing DR" highlights how each level of response reflects a different valuation component, something the SPM does not capture. For example, DR at levels 1-2 often has competitive market or regulatory mechanisms for establishing the value of kW and kWh impacts. However, at levels 3-5 there is no market mechanism to establish the value of DR. Levels 3-5 transitions from commodity market values to customer service values. Both the scope and methodology for valuing DR need to address these issues.

Figure 1. Conceptual Framework for Establishing Demand Response Value



A revised, more comprehensive DR valuation model must address several concerns, including:

1. How can DR value be evaluated and continue to reflect both a utility supply-oriented perspective and a broad envelop of quantifiable and qualitative customer and system wide costs and benefits?
2. While DR currently exists as a population of independent reliability and price responsive programs, how can DR be represented as part of a hierarchy of customer actions that link energy efficiency and DR in a value continuum?
3. What are the impacts to both the DR valuation scope and methodology if baseline default tariffs (e.g. CPP) establish DR as an implicit condition of service for all customers?
4. What form of analytical model or set of models can be used to properly capture the quantitative and qualitative metrics that comprise DR value?

R&D Task Objectives

Conduct one or more tasks to satisfy two primary objectives, specifically: (1) develop a more comprehensive DR conceptual valuation framework and (2) develop a more comprehensive analytical methodology or methodologies capable of addressing different stakeholder and resource perspectives. Proposals may address either one or both primary objectives. In all cases the projects should consider each of the following:

- How can a DR valuation method consider the hierarchy of customer actions that link energy efficiency, frequent time-of-use, and less frequent DR response in a value continuum as a demand side response strategy and a demand side resource? How can the value to the customer, to the utility, to the ISO, and to society be best expressed? Can valuation methodologies developed to assess environmental impacts, technology and information system or other non-utility investments be applied to DR? How can the value to the customer be expressed to improve customer adoption and response?
- How should DR be defined? To what extent have recent advances such as appliance efficiency standards, improved digital controls, changes in consumer rights, the internet and other factors created a need to reexamine the basic definition and new opportunities for the scope of DR and the relevance of existing SPM methodologies and assumptions?
- What purpose should a DR evaluation methodology fulfill? Is the purpose to compare alternatives on a common basis, measure the relative efficiency of various alternatives, construct an optimum resource plan – or some other combination? Should separate evaluation methodologies be used to assess each perspective or can a single methodology fulfill this purpose? Given a clearly defined purpose, how can results be interpreted and what are the limitations?
- Establish a revised DR analytical framework that reflects the perspectives of each DR stakeholder. The framework should identify each DR impact and how each should be valued. Any methodology must address two basic factors: (1) all material impacts must be identified and (2) each of the impacts must be monitized or valued so that options can be compared on a common basis.

The framework must also address each of the following factors:

- **Short-term and long-term impacts** –Are load and energy (kW and kWh) impacts reported by utilities short-term observations or are they sustainable in the long-term? How can persistence of savings be measured and quantified?
- **Quantitative and qualitative impacts** – In addition to load and energy impacts, DR can provide customers with bill management opportunities, additional information services, and create system wide environmental impacts. Are these impacts significant? If so, how can they be measured or monitized? Consider service and amenity level, duration and frequency of shed, and reliability versus price responsive programs.
- **Risk and opportunity costs** –DR infrastructure can provide utilities with operating flexibility to adapt to rapidly changing market conditions. How much of this investment is needed? What is the value of the opportunity cost from not investing in DR? How can this value be captured with a business case methodology?

- **Utility versus customer infrastructure ownership** - DR program designs generally assume that the utility owns and operates the meters, communication and control equipment. What are the profit versus cost, operational, benefit/cost and other tradeoffs between utility, third-party and customer ownership? How can a methodology be designed to systematically examine these impacts in a DR evaluation? What methodologies can best support DR valuation and integration into current resource plans? What methodologies are used today? Design and implement a DR value interview for the California ISO, IOUs, municipal utilities, and western market resource planners to evaluate current methodologies.
- **Obligation to Serve** - Examine the implications of the obligation to serve and how it is potentially impacted by pending California tariff and metering initiatives, DR technology and a more comprehensive DR evaluation framework. For example, the CPP rates being considered as the default tariff for all customers in California combine both TOU and dispatchable critical peak rate elements. The TOU elements, like inverted tier rates provide incentives for energy efficiency. The dispatchable critical peak elements provide incentives for DR. State pricing policy that includes both in a default tariff integrates efficiency and DR and embeds both as underlying conditions of service. How might this change in pricing policy impact state outage management plans and the development of mandatory system protection options derived from more conventional DR technologies? Would this change in pricing policy effectively redefine the obligation to serve?

Resources

1. Developing A Demand Response Business Case Methodology Project Plan, California Energy Commission, by Levy Associates, August 2003.
2. A Framework and Review of Customer Outage Costs: Integration and Analysis of Electric Utility Outage Cost Surveys, Lawrence Berkeley National Laboratory, LBNL-54365, November 2003, by Gyuk, DOE; Lawton, Sullivan, Liere, Katz, Population Research Systems, LLC, and; Eto, LBNL. Available at http://certs.lbl.gov/CERTS_P_Reliability.html#qualityResource Adequacy, Final Report, January 2005, A Joint Project of the Center for the Advancement of Energy Markets and the Distributed Energy Financial Group, LLC. (where available).
3. Demand Response Valuation, Presentation at the International Demand Response Seminar, by Dan Violtte, Sponsored by the International Energy Agency (IEA) Demand-Side Management Programme, available at http://drrc.lbl.gov/drrc-iDRseminar.html.
4. "Quantifying the Air Pollution Exposure Consequences of Distributed Electricity Generation", May 2005, Garvin A. Hath, Patrick W. Granvold, Abigail S. Hoats, William W. Nazaroff.
5. Resource Adequacy and the Cost of Reliability: The Impact of Alternative Policy Approaches on Customers and Electric Market Participants, January 2005, A Joint Project of the Center for the Advancement of Energy Markets and the Distributed Energy Financial Group, LLC.
6. Evaluation Framework and Tools for Distributed Energy Resources, February 2003, Prepared for the Distributed Energy and Electric Reliability Program, Assistant Secretary for Energy Efficiency and Renewable Energty, U.S. Department of Energy, by Gumerman, Bharvirkar, Hamachi LaCommare, Marnay at the Ernest Orlando Lawrence Berkeley National Laboratory.
7. Distributed Generation Costs and Benefits Issue Paper, July 2004, Mark Rawson, Public Interest Energy Research, California Energy Commission.

Acronyms

CEC	California Energy Commission
CPP	Critical Peak Pricing
CPUC	California Public Utilities Commission
DR	Demand Response
HVAC	Heating Ventilating and Air Conditioning
ICAP	Installed Capacity
IOU	Investor Owned Utility
ISO	Independent System Operator
kW	Kilowatt
kWh	Kilowatt hour
RON	Research Opportunity Notice
SPM	Standard Practice Methodology
SPP	Statewide Pricing Pilot
TOU	Time of Use

Glossary

Advanced Metering Infrastructure (AMI): Electricity meters and associated equipment that can, to varying degrees, record, process, and transmit time specific information about a customer's electricity usage. Interval metering, recording at least hourly usage data, is the basic and most common form of advanced metering.

California Energy Commission (CEC): A California regulatory agency charge with the authority to site power plants, maintain the Title 24 Building and Appliance Standards, support the development of demand response and provide research on technologies relevant to all of its areas of authority.

California Public Utilities Commission (CPUC):   A California regulatory agency charged with the authority to adopt rates and oversee the performance of investor owned electric utilities, with related authority over water, gas, telephone and other public service entities.

Critical Peak Pricing (CPP): A retail electricity pricing rate on which customers are charged a high price during a limited number of critical peak periods initiated in response to electricity market or system conditions such as wholesale price spikes or supply shortages. Depending on the particular tariff, the critical peak price may either be fixed at a pre-determined level or varied to reflect short-term market or system conditions. Critical peak pricing may be combined either with a standard Time-of-Use rate or a flat rate.

Demand Response (DR): Demand Response includes all intentional modifications to the electric consumption patterns of end-use customers that are intended to modify the timing or quantity (including both the level of instantaneous demand (capacity), and total consumption (in kWh or MWh) of customer demand on the power system.

Energy Efficiency: Reducing the energy used by end-use devices and systems while maintaining comparable service, generally achieved by substituting technically more advanced equipment and practices to produce the same level of end-use service with less electricity.

Heating Ventilating and Air Conditioning (HVAC): A term used to refer to the air conditioning systems that includes packaged units used in residential and small commercial and industrial facilities as well as the components (chillers, air handlers, etc.) used in larger facilities

Inverted Block, *Inverted Tier Rate*: A retail electricity rate on which customers are charged progressively higher flat rates for successive increments of electricity usage in each billing cycle.

Obligation to Serve: A common law concept that requires regulated electric utilities to provide adequate, affordable and reasonably efficient services to all customers without unjust discrimination.

Rate Forms: The combination of charges used to compute the customer utility bill.

Real Time Pricing (RTP) Rate: A retail electricity rate on which customers are charged prices that vary by hour and reflect hourly variations in wholesale electricity prices. Real time pricing tariffs may vary with respect to a number of other options, such as the availability of price hedging options (e.g., price collars) and the components of the electricity service (generation, transmission, and distribution) billed at the hourly rates.

Standard Practice Methodology (SPM): A multi-part cost benefit methodology under jurisdiction of the California Public Utilities Commission (CPUC) used by the CPUC, utilities and program planners to quantify the costs and benefits of conservation and demand response initiatives.

Statewide Pricing Pilot (SPP): A joint pilot program to test the demand response capability of Critical Peak Pricing (CPP) involving 2,500 customers over a two year period (2003-2004) conducted by Pacific Gas & Electric (PG&E), Southern California Edison (SCE) and San Diego Gas & Electric (SDG&E) in conjunction with the California Energy Commission (CEC) and California Public Utilities Commission (CPUC).

Time of Use Rate (TOU): A retail electricity rate on which customers are charged according fixed price tiers that apply to specified times of the day and days of the week.